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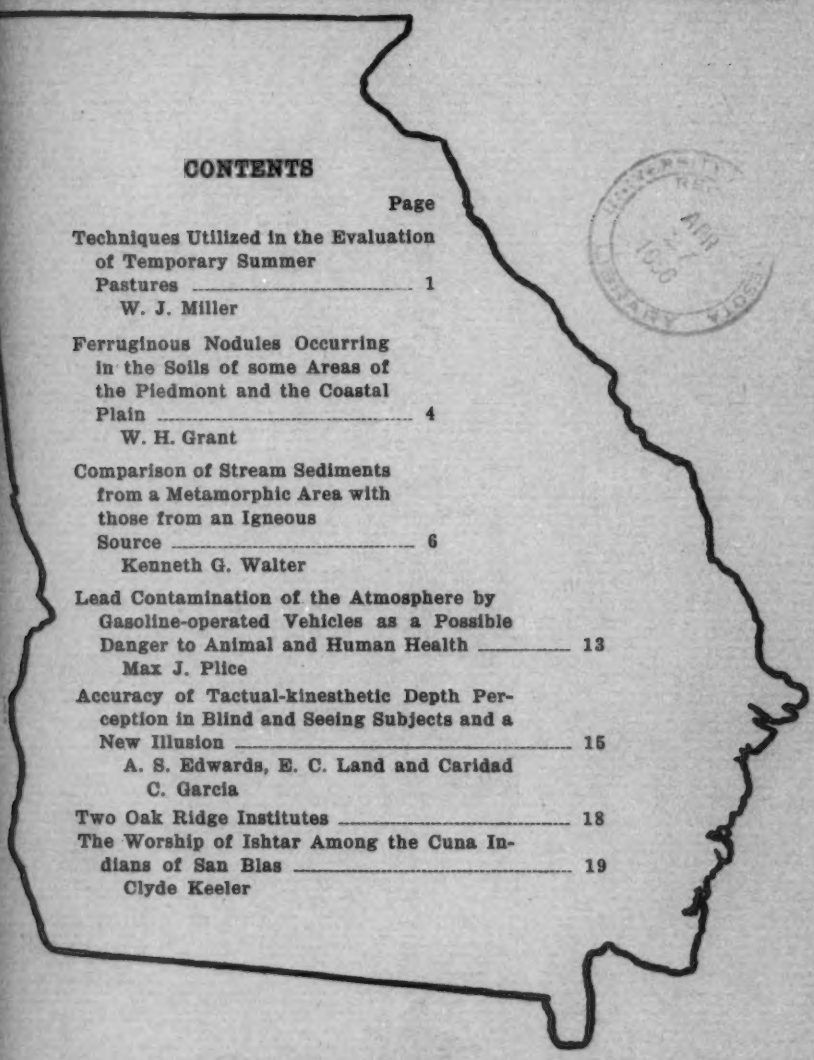

CONTENTS

Page

Techniques Utilized in the Evaluation of Temporary Summer Pastures 1
W. J. Miller

Ferruginous Nodules Occurring in the Soils of some Areas of the Piedmont and the Coastal Plain 4
W. H. Grant

Comparison of Stream Sediments from a Metamorphic Area with those from an Igneous Source 6
Kenneth G. Walter

Lead Contamination of the Atmosphere by Gasoline-operated Vehicles as a Possible Danger to Animal and Human Health 13
Max J. Plice

Accuracy of Tactual-kineasthetic Depth Perception in Blind and Seeing Subjects and a New Illusion 15
A. S. Edwards, E. C. Land and Caridad C. Garcia

Two Oak Ridge Institutes 18

The Worship of Ishtar Among the Cuna Indians of San Blas 19
Clyde Keeler

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TECHNIQUES UTILIZED IN THE EVALUATION OF TEMPORARY SUMMER PASTURES

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In evaluating any pasture crop we are concerned with two general aspects of the pasture. The first is the yield, both seasonal and total. The second is the quality of the forage. First let us discuss techniques of measuring yield. One of the simplest and cheapest ways is that used by agronomists in their plot work of clipping and weighing the forage. This technique is useful for screening large numbers of combinations of treatments. However, results often are quite different from those obtained with grazing animals. Mentioning only one reason, some forages are injured more by the trampling of grazing animals than are others. Accordingly, actual grazing studies are needed for the final evaluation.

It is impossible to weigh or accurately sample the material which animals graze. If the forage is cut and fed to an animal it is not grazing and many circumstances are changed. Therefore, a number of indirect measures are employed to determine yield, quality, etc.. in a pasture. One of these indirect measures is the use of feeding standards in reverse to estimate nutrients by animal performance. A feeding standard is an estimate of the amount of nutrients which an animal requires for each function. For example, the energy requirement of a dairy cow may be expressed as total digestible nutrients and this amount divided into the requirements for 1). maintenance, 2). gain or loss in weight, and 3). milk production. When the amounts of nutrients which are required for each function are totaled we have an estimate of the amount which the cow consumed. However, lactating cows are usually fed some supplementary feed, and the total digestible nutrients in this, obviously, must be subtracted from the total required for the various functions. The answer is an estimate of the amount of total digestible nutrients which the cow obtained from the pasture. It is a combination measure of both the quality and the quantity of the forage.

Several other measures of total yield are frequently used. One of these is cage clippings in which an area is covered with a cage during the grazing period to determine the amount of forage which would have been in the field had it not been grazed. However, a number of additional steps are necessary. At the end of the grazing period some forage will usually remain on the grazed field. Therefore an area must be clipped from the grazed portion and this forage subtracted from that obtained under the cage to obtain an estimate of the amount eaten. In some instances this growth under the cage

1. Several others have made contributions to the studies including: E. R. Beaty, L. M. Underwood, H. L. Dalton, J. D. Donker, J. C. Mahaffey, T. H. Rogers and others.

is different from that in the grazed area. This frequently is due to a more rapid growth rate where there is more leaf surface for photosynthesis. Therefore, a formula was developed by Linehan *et al.* (1947) to adjust for this differential growth rate. Also, to minimize it and other variables new locations are chosen for the cages at frequent intervals. Even with these adjustments there still may be an average discrepancy between estimates of yields from cage clippings and estimates from animal performance, due to the nature of the forage. For example, we have observed that cage clippings gave a relatively higher yield on Sudan than on millet. The reason was readily apparent. A great many more of the taller, stiffer Sudan plants were broken and wasted by the grazing cows. Estimates of yields determined by the animal performance method have considerably smaller coefficients of variation than those obtained by cage clippings. This is another reason why they are regarded as being a better indication of the value of a pasture for grazing purposes.

Another way that we measure yield is to make an estimate of the amount of forage consumed and its digestibility. Obviously, conventional techniques will not work. However, digestibility and forage intakes can be measured by the use of a combination of two indigestible indicators. One must occur naturally in the feed and the other is given the cow in known amounts. "Chromogens," which are plant pigments consisting largely of chlorophyl, frequently are used as the naturally occurring indicator. Since it is impossible to sample objectively and accurately, the type of forage an animal is grazing, all of the information should be obtained from fecal samples. These samples must be taken at a time of day when they will be representative of the whole day's output. After the amount of chromogens in the feces is determined, a formula developed by Reid, *et al.* (1952) is used to calculate the amount in the forage. This is possible because there is a definite curvilinear relationship between the chromogen content of the feces and that of the forage intake. Then, by the use of the ratio of the amount of chromogens in forage and in the feces, the digestibility is calculated. The digestibility coefficient can be used in conjunction with the cage clippings to calculate the yield of digestible nutrients.

The indicator which we usually give the cow is chromic oxide. A typical amount is 20 grams per day and since it is indigestible she will excrete the same amount. Then we determine the amount of chromic oxide in a given quantity of feces and, knowing that 20 grams are excreted daily, a ratio is used to calculate the amount of feces that was excreted during the day. However, because of considerable diurnal variation in the chromic oxide content of the feces it is necessary to choose a time schedule of collecting fecal samples that will give samples representative of the whole day's output. (Mahaffey, 1954.)

When the amount of feces excreted and the digestibility of the forage are known it is very simple to calculate the amount of forage eaten.

At the beginning it was mentioned that we are interested in deter-

mining the quality of the forage as well as its yield. In the discussion of methods of measuring yield several measures which also estimate quality have been mentioned. One of these is digestibility. One very important advantage of the digestibility measurement is the high degree of precision with which it can be measured. Coefficients of variation of about 2.0% are easily obtained. The amount consumed is another criterion of quality. It is important since, regardless of the nutritive value per unit of the forage, animals will not perform well unless they consume adequate quantities. Chemical analyses give some indications of nutritive value, and are especially suitable where large numbers of comparisons are desired. Of the chemical analyses, protein determinations have been employed most often. They are useful in two respects; 1) animals must have protein in adequate amounts for proper nutrition, and 2) under usual circumstances young plants are high in protein and the protein content decreases with increasing maturity. Nutritive value also decreases with increasing maturity. However, under certain circumstances, such as with high nitrogen enrichment, protein content may remain relatively high, yet the forages decrease in nutritive value. Under such conditions crude fiber and lignin increase with maturity of the plant and therefore are much better measures of maturity and nutritive value.

Animal performance is always the final criteria of the quality of a forage. Unfortunately, it is one of the most difficult and expensive measures to obtain. Therefore, it is reserved for the most important comparisons. In dairy cattle we are very vitally concerned with the milk production which can be obtained from a forage. There are a large number of forages on which satisfactory beef gains are obtained but on which milk production is not satisfactory. The persistency with which milk production is maintained is a very useful measure of forage quality.

It is well known that the milk producing abilities of different cows varies considerably. In initiating an experiment, ordinarily we do not have a great many cows from which to choose, because of the limited numbers of suitable cows available, and are not able to balance the groups nearly as well as could be desired. Nevertheless, we are able to obtain relatively precise estimates of milk production. In order to obtain greater precision we have used a cross-over or reversal design in which one group of cows receives the first treatment during the first period and the other treatment during the following period. (Brandt, A.E., 1938.) Another group receives the opposite schedule. By this design each cow serves as her own control and the linear effect of the time trend as well as any differences due to time are removed. Cows which are between the 6th week and the 7th month of the lactation, throughout the experiment, are used, because during this period the milk production is normally declining at a linear rate. Where the conditions are suitable a double reversal or 3 period design gives higher precision than the single reversal or 2 period design. In our Sudan vs. millet experiments in 1954, a comparison was made of results obtained by the

single and double reversal designs. It was found that under the conditions of these experiments that the single reversal design was more efficient. Apparently, the grazing season was so short and the seasonal changes of sufficient magnitude to more than offset the advantages of the normally more efficient double reversal design.

The proper evaluation of various pasture treatments involves many unusual problems. Accordingly, many specialized techniques must be developed and used with considerable skill in order to answer the questions which are of importance to dairy farmers.

REFERENCES

Brandt, A. E. 1938. Tests of Significance in Reversal or Switchback Trials. Iowa Res. Bull. 234.

Linehan, P. A., Lowe, J. and Stewart, R. H. 1947. The Output of Pasture and Its Measurement. Part II. J. British Grassland Society. 2: 145-168.

Mahaffey, J. C. 1954. The Effects of Certain Factors on the Diurnal Excretion Pattern of Chromic Oxide. Unpublished Masters Thesis. University of Georgia.

Reid, J. T., Woolfolk, P, G., Hardison, W. A., Martin, C. M., Brundage, A. L. and Kaufmann, R. W. 1952. A Procedure for Measuring the Digestibility of Pasture Forage Under Grazing Conditions. J. Nutrition, 46: 255-269.

FERRUGINOUS NODULES OCCURRING IN THE SOILS OF SOME AREAS OF THE PIEDMONT AND THE COASTAL PLAIN*

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The occurrence of ferruginous nodules in the surface soils has been noticed by many field geologists in the southeast. Nodules from Hart County, DeKalb County and in Dodge County, near Eastman, Georgia constitute the material to be described here, although nodules have been noted from other parts of the crystallines. The specimens from the Coastal Plain near Eastman were given to the writer by Dr. A. S. Furcron of the Georgia Geological Survey and were described by him in an issue of the Georgia Mineral Newsletter.

The nodules are generally small, ranging from 5 mm. to two or three centimeters in their maximum diameter. Most of them have shapes which resemble stream worn pebbles. The nodule surfaces are usually smooth but some are roughened by protruding sand grains. They range from dark to light brown colors, some having a yellowish cast while others have a reddish cast. Cross sections of most of the nodules show a brown core darkening in the immediate vicinity

*Paper read before the Earth Science Section of the Georgia Academy of Science, Mercer University, 1953.

of the periphery. A few nodules have a brownish-yellow core and a reddish periphery. This color band is not concretionary but consists simply of a peripheral band which grades rather sharply into the central core. In some nodules the peripheral band is absent. The streak of the nodules varies from very dark brown to a limonite yellow. Hardness varies from 4 to 1.

Nodules from crystalline areas often include mineral fragments such as sillimanite, mica, quartz, garnet, and rarely hornblende, and magnetite. Some nodules contain fragments of underlying rock, for example, a fragment of schist preserved in recognizable condition encased in iron sesquioxides. Specimens from the Coastal Plain contain only fragments of quartz. Minerals included in the nodules are usually traceable to a rock in the immediate vicinity. The origin of the quartz grains in the Coastal Plain samples is unknown but it seems probable that a similar situation obtains.

One of the most striking properties of many nodules is that they are attracted to a magnet. The specimens from the Coastal Plain are remarkably magnetic and in a few instances exhibit feeble polarity. Specimens from the crystallines are somewhat less magnetic and only one specimen showed a feeble polarity.

A few of the nodules were observed to contain small fragments of magnetite. However, the majority of the magnetic nodules contained nothing which had any of the megascopic or microscopic characters of magnetite, in the sense that it was derived from a preexisting rock. That is, no crystalline magnetite was found in the nodules.

In a study of the magnetic nodules which contained no crystalline magnetite the following general characters were observed: streak is very dark brown, hardness is around 4 and the interior color is vary dark brown.

Since the nodules are not found in the underlying rocks they must originate in the soil. It is common knowledge that iron migrates downward and forms an enriched zone in the B soil horizon. Hence, the following studies were made to determine whether any magnetic oxides could be found in the soil. Four auger holes were drilled to depths of about 50 inches in stream alluvium and saprolite. The pH character of the soils was recorded for each hole and a series of samples collected. The work showed a general tendency for the soils to become more alkaline with increasing depth.

The magnetic properties of the soils were determined by a small electromagnet mounted on a microscope stage with pole pieces adjusted to be visible in the microscopic field. A small quantity of soil material was suspended in water and dropped between the poles of the electro-magnet. When the current is turned on any magnetic material orients itself in the field.

Comparison of magnetic soil particles shows them to be at least similar to those obtained by crushing nodules. Some of the particles had opaque centers surrounded by a translucent halo of a fuzzy, yellowish, collodial-appearing substance. Other particles had yellowish, red, fuzzy edges while still others had a greenish cast. Some of

the attracted particles were entirely translucent. Generally all magnetic particles had a collodial appearance.

H. B. Weiser (1935), found that a geletinous ferro-ferric oxide Fe_3O_4 is obtained by adding alkali to a solution containing equivalent amounts of Fe''' and Fe''. If this precipitate is dried out of contact with air, it becomes a brownish black mass which is magnetic and contains an indefinite amount of water. The x-ray diffraction pattern for this precipitate is the same as for magnetite, Fe_3O_4.

The equation given for this reaction is $2Fe(OH)_2 + Fe_2O_3 \cdot H_2O \rightarrow FeO \cdot Fe_2O_3 + 2H_2O \cdot Fe(OH)_3$. It has an isoelectric point at pH 5.2. Thus in an alkaline medium it takes on an acid character and reacts with the still un-ionized strongly basic $Fe(OH)_2$ to from the ferrous ferrite $FeOFe_2O_3$ or Fe_3O_4. Conditions favoring this reaction in addition to the pH is a low supply of oxygen.

Measurements made in the soil show that the pH conditions are satisfied. The supply of $Fe(O)_2$ can be obtained by reduction of $Fe(OH)_3$ by plant remains or it may come directly from mineral decomposition in an oxygen poor environment. The condition of limited oxygen supply can probably be satisfied in clay soils.

The absence of nodules in the underlying rock and the inclusion within them of fragments and minerals from the underlying rock indicate that the nodules must have formed in the overlying soil or saprolite. The existence of similar magnetic particles in the nodules and in soils supports this idea. It is chemically feasible for "magnetic" iron oxides to form in the weathering environment.

It is concluded that the magnetic nodules were formed in the soil and were brought to the surface by erosion.

REFERENCE

Weiser, Harry B. Inorganic Colloid Chemistry, Vol. II, The Hydrous Oxides and Hydroxides. John Wiley, 1935.

COMPARISON OF STREAM SEDIMENTS FROM A METAMORPHIC AREA WITH THOSE FROM AN IGNEOUS SOURCE*

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The streams whose sediments were studied flow in the vicinity of Stone Mountain, in DeKalb County, Georgia. They are Lake Creek south of the mountain, and Stone Mountain Creek along with its unnamed tributary north of the mountain. Fed mostly by runoff and

*With the exception of the Addendum, which was added later, this paper was presented at the 1955 meeting of the Georgia Academy of Science, Earth Science Division, in Athens, Georgia.

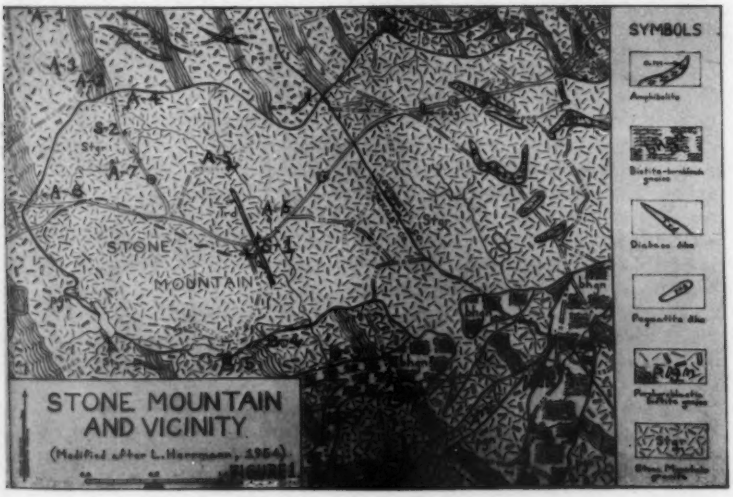
seepage, they are southward-flowing parts of the Altamaha drainage system.

Figure 1 is a geologic map on which are marked the locations of the different sample sites. Sites A-1 through A-4 are located in porphyroblastic biotite gneiss in which there are interlayered garnetiferous gneisses, biotite schists, and quartzites (Hermann, 1954). Samples A-7, A-8, B-4, and B-5 were taken from those parts of streams which flow over Stone Mountain granite and which did not rise in metamorphic rocks. This granite is predominantly a biotite-bearing muscovite granite. Because samples A-6 and B-1 through B-3 contain mixtures of igneous and metamorphic rock particles, not much attention need be paid to them except to note that they contain minerals and other characteristics of both provenances.

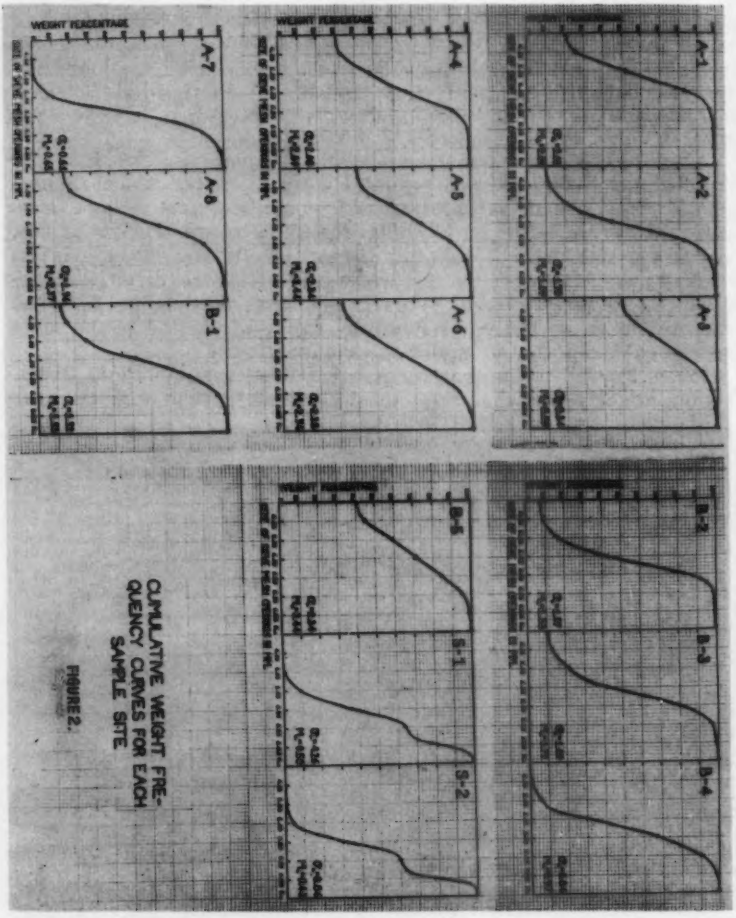
All samples were collected from the upstream sides of prominent sand bars. The samples were dried in open air, after which slightly less than 200 grams of each were split off for analysis. The samples were run on a Ro-tap for ten minutes, using A.S.T.M. sieve mesh sizes of 5, 10, 18, 35, 60, and 120 plus a pan.

After screening, a cumulative weight frequency curve was constructed for each collection point (Figure 2), after which random samples from the modal class (0.5-1.0 mm) were placed in a Seeoscope and grain outlines traced to determine shape and roundness. The arithmetic mean (Ma) and the arithmetic standard deviation (Oa) were then calculated to determine sorting characteristics peculiar to the two different types in the area. The values for each site are shown by Table 1. Random samples from the modal class were then taken for mineralogical examination.

Tables 2 and 3 show that there is a fairly even sphericity distribution, slightly less than 0.69 to slightly more than 0.95, for the



metamorphis particles whereas the sphericity values for the igneous rocks tend to be clustered around 0.70 to 0.80 (in samples south of Stone Mountain) or 0.85 - 0.89 (in samples north of the mountain). The average roundness value for the igneous particles is about 0.22 while the average roundness values for the metamorphic particles range from 0.13 to 0.30 and exhibit no clustering. Nothing significant is apparent from the standard deviation calculations. Some of the cumulative curves show good and others show poor sorting; there is no constancy as to provenance. Figure 3 shows the changes in standard deviation along the two most important streams that were studied.



CUMULATIVE WEIGHT FREQUENCY CURVES FOR EACH SAMPLE SITE

FIGURE 2.

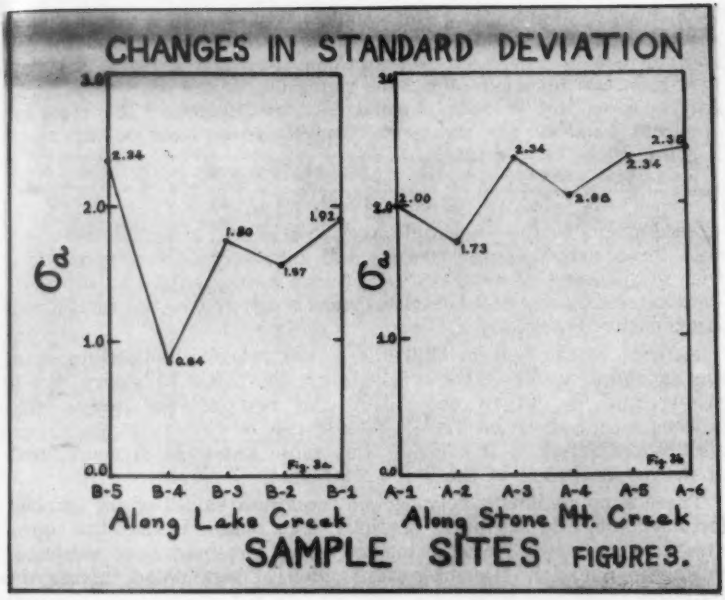


TABLE 1

SAMPLE SITES	σ_ϕ	M_ϕ
A-1	2.00	2.87
A-2	1.73	1.69
A-3	2.34	3.89
A-4	2.08	2.89
A-5	2.34	3.44
A-6	2.38	2.94
A-7	0.61	0.65
A-8	1.96	2.37
B-1	1.92	1.93
B-2	1.57	1.53
B-3	1.80	1.72
B-4	0.84	0.97
B-5	2.34	3.44
S-1	4.26	0.50
S-2	3.86	0.43

Table 4 lists the minerals of each sample in their approximate order of frequency. Differences between igneous and metamorphic sediments can readily be seen. Generally, there is a decrease in hornblende, zircon, staurolite, epidote, and magnetic in going from the metamorphic to the igneous environment. In proceeding from the igneous to the metamorphic area, there is a decrease in tourmaline, feldspar, and muscovite. Samples A-6 and B-1 through B-3 show the expected mixtures of igneous and metamorphic minerals. The mixture in B-5 is thought to be due to contaminating transported rocks in the earth fill which dams up the like, since part disappears in B-4.

The following conclusions may be drawn: (1) metamorphic particles vary in sphericity while igneous ones are confined to the lim-

its mentioned above, (2) metamorphic particles vary more in roundness than do the igneous, and neither stream volume nor width, both of which are less in the streams from the igneous area, appear to affect the constancy of the roundness of the igneous particles and the constancy of their sphericity, (3) no differences in sorting are apparent between the sediments derived from igneous and metamorphic rocks in this area.

ADDENDUM

Subsequent to the presentation of this paper, a need became evident for a comparison of igneous and metamorphic stream particles with the particles of an igneous saprolite. Accordingly, two saprolites were sampled and their loosened grains subjected to the same treatment outlined above.

As seen at the bottom of Table 2, the sphericity distribution of the saprolite particles shows clustering in the 0.75 group - 0-80 group, and is rather even over the rest of the range. The igneous sediments from Lake Creek, south of Stone Mountain, are also concentrated in this range, but those from the streams north of the mountain are in the 0-85 - 0.90 class.

There is no similarity between the roundness values of the igneous, metamorphic, and saprolitic particles. The reason is that the saprolites have undergone weathering only and have not been subjected to stream abrasion. An interesting sidelight was noted during the saprolite roundness determinations. At site S-1, twenty-one per cent of the particles examined differ from 0.1 in roundness, whereas only four per cent of those of S-2 differ from 0.1. Several possible explanations can be mentioned. An obscure mineralogical difference may exist between the granites of the two separate localities with some of the minerals at one being less resistant to weathering. This would permit more breakdown and splitting apart of mineral groups. Crystallographic variations may be the explanation, or solution by circulating groundwater.

Table 4 shows the mineral content of the three kinds of samples. There is a strong similarity between the igneous and the saprolitic minerals, except the minor accessory minerals, but there is no close similarity to the constituents of the metamorphic areas.

Calculations of the standard deviation and the arithmetic mean show no apparent significance, as in the case of the stream sediments. For purposes of comparison they may be seen in Figure 2 along with their respective cumulative weight frequency curves. The curves for S-1 and S-2 reveal points of inflection for which the author cannot account. Perhaps they merely indicate what might be a larger than expected amount of particles in the 1.00 - 0-50 and 0-50 - 0.25 millimeter sieve mesh opening sizes.

In summary, the Phi determinations of the saprolites in part agree favorably with those of the igenous grains, with the exceptions noted above. Roundness calculations, however, are inconclusive, as are also the figures for standard deviation and arithmetic mean. The cumu-

TABLE 2

ABSOLUTE PHI-RANGE FREQUENCIES

Sample	<0.69	0.70–0.74	0.75–0.80	0.81–0.84	0.85–0.89	0.90–1.00
A-1	8	10	10	10	6	6
A-2	2	10	6	6	6	2
A-3	2	10	8	10	6	4
A-4	4	14	2	6	-	8
A-5	6	8	4	6	4	-
A-6	4	4	12	6	10	6
A-7	6	4	12	2	8	-
A-8	6	6	4	6	14	2
B-1	2	4	8	6	6	2
B-2	6	6	6	8	2	4
B-3	6	6	8	8	4	2
B-4	2	16	6	4	2	-
B-5	12	2	12	-	2	4
S-1	4	2	9	4	5	-
S-2	-	4	10	8	8	-

TABLE 3
ABSOLUTE ROUNDNESS
FREQUENCIES

SAMPLE SITE	0.1	0.2	0.3	0.3	0.5	AVERAGE
A-1	—	20	18	14	2	0.29
A-2	10	10	6	2	4	0.24
A-3	2	10	14	14	—	0.30
A-4	4	20	10	—	—	0.22
A-5	4	14	4	2	4	0.26
A-6	20	10	2	8	—	0.20
A-7	2	22	6	2	—	0.22
A-8	6	22	8	2	—	0.22
B-1	2	12	10	4	—	0.26
B-2	6	12	14	—	—	0.22
B-3	8	22	4	—	—	0.13
B-4	6	18	6	—	—	0.20
B-5	6	12	8	6	—	0.24
S-1	19	4	—	1	—	0.13
S-2	23	—	1	—	—	0.11

lative weight frequency curves for S-1 and S-2 also fail to compare with those for igneous and metamorphic sediments. Lastly, the mineral content of the saprolites agrees broadly with that of the igneous areas.

TABLE 4

MINERAL CONTENT OF SAMPLES

A-1 Quartz Hornblende Epidote Garnet Biotite Magnetite Muscovite	A-2 Quartz Hornblende Garnet Feldspar Zircon Magnetite	A-3 Quartz Hornblende Magnetite Staurolite Muscovite Garnet Epidote
A-4 Quartz Hornblende Magnetite Zircon Feldspar	A-5 Qaurtz Hornblende Biotite Epidote Magnetite Vermiculite	A-6 Quartz Hornblende Zircon Biotite Muscovite Vermiculite Magnetite Epidote
A-7 Quartz Feldspar Muscovite Tourmaline Magnetite	A-8 Quartz Feldspar Muscovite Tourmaline Magnetite	B-1 Quartz Zircon Tourmaline Biotite Magnetite Feldspar Hornblende (?)
B-2 Quartz Magnetite Biotite Feldspar Zircon Tourmaline	B-3 Quartz Tourmaline Feldspar Muscovite Garnet Magnetite	B-4 Quartz Feldspar Biotite Tourmaline Muscovite Garnet Hornblende Magnetite
B-5 Quartz Hornblende Zircon Biotite Epidote Feldspar Magnetite	S-1 Quartz Feldspar Muscovite Biotite altering to Vermiculite Hornblende Tourmaline Garnet Magnetite	S-2 Quartz Feldspar Muscovite Biotite altering to Vermiculite Lepidolite (?) Hornblende Apatite Magnetite

BIBLIOGRAPHY

Herrman, Leo A. "Geology of the Stone Mountain-Lithonia District, Georgia." *Georgia Geological Survey Bulletin, No. 61. (1954).*

LEAD CONTAMINATION OF THE ATMOSPHERE BY GASOLINE-OPERATED VEHICLES AS A POSSIBLE DANGER TO ANIMAL AND HUMAN HEALTH

MAX J. PLICE

In the science of animal and human nutrition the functions of several of the major mineral elements, or those found in largest amounts, in feeds and foods are fairly well understood at present. However, of the comparatively large number of minor, or trace, elements which occurs in all natural food substances only a half dozen, or so, are much more than mentioned in nutritional literature. Even then they are spoken of rather guardedly and their function is said to be mostly "catalytic." At present this seems to mean that they are generally considered to be necessary food elements.

Much more time and study has been devoted to the relationship of the minor mineral elements in foods to human health and well being than to those for farm animals. In order to correct—partly, at least—for this situation in Georgia, the Georgia Department of Agriculture instituted a program, several years ago, to study the action and possible function of the trace elements in farm-animal feeding. One of the purposes involved was a study of the trace-element composition of the various organs and parts of normal, or healthy, animals versus that of abnormal or unhealthy, animals. Another purpose was to determine the trace-element composition of the common farm crops which are fed to the animals and which are grown on different soils under different cultural and management conditions. The major purpose was to determine how a feed with a certain trace element make-up would influence the blood composition of an animal as well as its health and productivity. All mineral determinations were made by using a one-and-on-half meter Bausch and Lomb spectrograph, using both arc and spark excitation.

During the study of the photographic plates for the presence and concentration of trace elements in the various feeds and forages it was noticed that the lines for lead (Pb) showed up prominently in all spectrographed samples. In fact, in a number of samples the lead lines showed so strongly that contamination was suspected. Investigation of this matter proved, however, that the lead was really present in the samples and in seemingly extraordinary amounts. Since lead is widely regarded as a dangerous toxic substance its presence in the materials herein studied seemed to demand an explanation and to warrant further study. This led to a search of the literature for data which might show the lead content of plant materials, feeds, and food products. The search was quite unrevealing. However, three works which dealt with quantities of lead contained in human tissues were found.

In a U. S. Air Force Report (1) the lead content of human blood—average of two "normal" males—was shown to be one-half part per million (P.P.M.). The Oak Ridge National Laboratory re-

ports (2) that lead was found in every human tissue examined, from barely detectable to "considerable" amounts—no figures being given. In a Manual of Pharmacology, by Sollman (3), the subject of lead in human bodies is discussed at some length. It is there stated that lead tends to accumulate in the bony parts of the body and that the lead content of the bone ash of normal, mature persons is approximately 3 p. p. m. In light of these apparently small accounts of lead found in the human body the amounts of lead found by the present study in vegetation in certain places are exceedingly large.

For example, in typical pasture grasses the lead contents were found to range from 8 p.p.m. to as high as 250 p.p.m. In all instances the largest amounts of lead were found to occur in samples taken near much-traveled automobile highways, and the smallest amounts in samples taken at some distance from highways. It began thus to appear that proximity to busy highways was the deciding influence in the amounts of lead which the plants contained. This, then, began to implicate gasoline-burning vehicles.

It is quite well known that most gasolines now used in cars and trucks are fortified with an organic lead compound (tetra-ethyl lead) in order to increase the octane ratings of the gasolines. Further, a bromine compound is also added to these fuels so that when they are combusted the lead will pass out of the exhaust system as a gas. This gas then mixes with the atmosphere from which vegetation seems to absorb it in its respiration process.

In order to test this reasoning it was decided to analyze vegetation growing actively along busy automobile and truck thoroughfares in town (Atlanta, Ga.). Since trees constitute the most common and consistent form of vegetation growing along city streets it was decided to collect leaves from several species of trees there and to compare them in lead content with leaves from the same kinds of trees growing at quite some distance from vehicular traffic. The time of leaf collection was late fall just prior to leaf abscission.

This study revealed that under the same conditions the various tree species absorb the lead gas to about the same extent and the closer the trees were to the streets the more lead they took up. It was found that leaves growing close to heavy traffic contained as high as 1500 p.p.m. of lead, while those growing one to two city blocks distant contained only 15 to 20 p.p.m. Bromine determinations were also made and it was seen that the bromine contents correspond to traffic intensity. From this it is believed that tree leaves absorb the lead bromine fumes as such.

No detailed pathological study was made of the different trees from which leaf samples were taken but, in general, the trees which were most distant from traffic seemed to be most thrifty. Whether the lack of thriftiness on the part of the other trees was entirely due to lead toxicity is not known.

From the information obtained it seems logical to believe that caution should be maintained by persons in using as food vegetables, fruits, etc., which grow in such gas-contaminated areas. Further, it is reasonable to believe that persons inhabiting atmospheres which

are highly polluted with exhaust vehicular gases would breathe-in these gases and the lead therein would be absorbed in their lungs. From the lungs some of the lead would very likely be translocated to other parts of the body. The total impact which such lead absorption by people might have on their health is not known.

REFERENCES

(1) U. S. A. F. Tech. Rpt. No. 6039—July 1951.
(2) Oak Ridge National Lab. Rpt. Central files No. C.F. 53-8-4.
(3) Sollman, T. A Manual of Pharmacology. 7th Ed., Saunders, Phila., 1949.

ACCURACY OF TACTUAL-KINESTHETIC DEPTH PERCEPTION IN BLIND AND SEEING SUBJECTS AND A NEW ILLUSION

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The psychological literature gives little on accuracy of non-visual space perception. One study on the accuracy of auditory depth perception by the senior author has been published (1955). The present report is of studies relating to distance perception which is wholly tactualkinesthetic. These were experiments performed under the direction of the senior author by two graduate students, Caridad Cristina Garcia (1954), and Ernest C. Land (1953).

The first series of experiments used seeing subjects; the second series included both seeing and blind subjects.

Series 1

Subjects. There were 50 Ss. chosen at random from the student body, aged 18 to 55. Most of them were of the earlier ages; four were instructors, and one was a negro.

Apparatus

Experiment 1. The apparatus consisted of three smooth sticks, 20 cm., 40 cm., and 60 cm. in length, all 2.5 cm. wide and 1.7 cm. thick fastened to a piece of beaver board of convenient size for handling, a meter scale, which was fastened securely to the desk, and a pair of goggles, which had been effectively blackened for use as a blindfold.

Experiment 2. The apparatus consisted of three smooth sticks, 20 cm., 40 cm., and 50 cm. in length, all 2.5 cm. wide and 1.7 cm. thick, a meter scale, and the goggles.

Experiment 3. The apparatus were the same but the sticks were fastened to a beaver board.

Procedures and Instructions. Detailed instructions were given to Ss to insure uniformity. These are too long to include in this report

but can be found in the original papers (1954) and (1953). There were three trials for each length stick. Sticks were presented in ABC-CBA order for alternate Ss. The blinfold was always used and S was told to use only the dominant hand. In Experiment 3, the hand was still and the sticks were moving. In this experiment sticks were placed both pointing away, and, pointing from side to side.

Series 2

Experiment 1. This experiment was planned to discover whether or not blind Ss were more accurate than seeing Ss in tactual-kinesthetic perception of distance.

Subjects. The seeing (control) group consisted of 26 women and 26 men, all students of the University of Georgia, aged 18 to 31. The experimental group were 32 blind adults, 24 men and 8 women, aged 21 to 60 years.

Apparatus. The apparatus consisted of a meter scale on which the Ss were asked to estimate distance, and goggles which had been effectively blackened for use as a blindfold. The blindfold was used for all Ss including the blind.

Procedure and Instructions. Each S was given three trials for each length and distance. The instructions were as follows: "The purpose of this experiment is to learn how accurately you can estimate distances by tactual-motor methods. You will be blindfolded and your dominant hand will be placed on one end of the yardstick and you will move your hand to the point you think corresponds to the measure asked, indicating with your fingernail the distance. We will use three different lengths—2, 16 and 20 inches—and there will be three separate trials for each length; they will be measured in vertical and in horizontal positions." Results were recorded in centimeters.

Results of Land's Experiments

With the hands moving and the stimulus still, the means for the 20, 40, and 60 cm. sticks were respectively: 19.71(S.D. 3.58), 38.97(S.D. 5.71), and 59.46(S.D. 2.87).

With the hand still and stimulus moving, for the 20, 40, and 50 cm. distances the means were respectively: 23.23(S.D. 3.11), 42.85 (S.D. 4.48), and 56.95(S.D. 5.70).

When the hand was moving and stimulus still, the distance was consistently underestimated; when the hand was still and the stimulus moving, the reverse was true.

Detailed statistical study (tables available in Land's thesis) show consistently greater accuracy in depth perception than in perception of lateral distance. The mean errors for the 20, 40, 60 and 40 cm. distances for distance perception were 3.71, 3.95, 3.58 and 4.30; for perception of lateral distances, 3.85, 5.95, 5.02 and 5.50. The average difference between the mean errors and the standard deviations for depth perception is 1.19; for lateral distance it is 1.82.

A New Illusion

During the experiment in which the hand was still and the scale moved, an illusion was reported that apparently had not been noted in psychological literature. Suddenly one of the Ss said: "I think you are trying to fool me." She explained the statement by saying that the scale seemed to be moving backwards. Another student, a psychology major, said suddenly during the administration of the experiment: "You know how wagon wheels seem to be going backward in the movies sometimes? I get the same sensation on this stick."

This report was investigated with Ss already being used and some additional Ss including faculty members, in all 57 Ss.

Of the 57 Ss, 14(24.5 per cent) reported the illusion voluntarily; 5(8.8 per cent) affirmed the illusion when asked; 25(43.9 per cent) reported the illusion when they were called back for retrial and questioned about the illusion; 8(14 per cent) denied feeling the illusion; 5 Ss had been in the experiment before the illusion was first reported and were not found and returned for the retrial.

Of the faculty members included above, two reported the illusion voluntarily; one did not notice the illusion at first but reported it on retrial, saying: "It would be hard to tell which way it is going." Two failed to report the illusion even with suggestion and retrial.

Assuming that it has not been reported before, we have called it The Land Illusion, since it was discovered and reported by Ernest C. Land.

(Note: On account of lack of space part of Land's experiments using cords instead of sticks has been omitted. For this see Land's thesis).

Results: Blind vs. Seeing Subjects

Garcia found that the blind, all of whom had had training in manual work, showed no superiority over the seeing Ss that was statistically significant. For the detailed statistical study, see her thesis. The seeing Ss were slightly superior in two, and the blind in four of the six sets of experiments, but in no case was the difference statistically significant. This contradicts the theory that the blind are superior in non-visual performance of this kind.

All measurements except the shortest (20.3 cms.) were underestimated by both groups, and for both groups the mean error increased as the length increased.

Comparing accuracy in the vertical and the horizontal positions, the control (seeing) group were better (but only at the 4 per cent level of significance) in perceiving vertical distance for one length, namely, 20.3 cms. No other superiority was found for either group on any of the lengths studied.

Conclusions

1. What appears to be a first report of the accuracy of tactual-kinesthetic distance perception has been made.

2. For all lengths used. perception was more accurate for distance perception than for lateral distance perception.

3. Experiments with blind and seeing Ss indicated no statistically significant difference between the two groups in the accuracy of tactual-kinesthetic distance perception.

4. A reverse tactual-motor illusion, not found in the literature, was reported.

REFERENCES

Edwards, A. S., 1955, Accuracy of auditory depth perception. J. Gen. Psychol. 52, 327-329.

Garcia, Caridad Cristina, 1954, A comparison of tactual-kinesthetic perception between blind and seeing subjects. Unpublished master's thesis, University of Georgia.

Land, Ernest C., 1953, A comparison of tactual-kinesthetic perception with tactual-kinesthetic lateral distance perception. Unpublished master's thesis, University of Georgia.

TWO OAK RIDGE INSTITUTES

The Special Training Division of the Oak Ridge Institute of Nuclear Studies will conduct two one-month institutes for science teachers next summer—one for secondary-school teachers, one for college and university teachers. Both summer institutes will be sponsored by the National Science Foundation.

The secondary-school institute is scheduled to be held June 11 through July 6. The institute for college and university teachers will be presented July 9 through August 3.

Both summer institutes are designed to provide selected groups of teachers in the physical sciences with up-to-date reviews of scientific developments, classical and modern, stressing that science should be taught and learned as a whole, rather than as a series of highly specialized and unrelated technologies. The institutes are specifically intended to improve the subject-matter competence of science teachers and to strengthen their capacity to motivate student interest in science.

Among the lecture topics for the institutes will be classical and modern physics; chemistry; mathematics; science expreiments; science-teaching methods; and radioisotope techniques. Both lecture and laboratory work will be incorporated into the curricula. A number of outstanding authorities in various fields of physical sciences will assist the ORINS Special Training Division staff in presenting the institutes.

No formal grant of academic credit is made by ORINS for attendance at these institutes, although participants may explore the possibilities of such arrangements with individual universities.

A stipend, including dependency allowance, applicable to traveling and living expenses, will be available to a number of participants; there is no fee for enrollment in the institutes. Participating teachers, visiting lecturers, and their families will be offered housing in a

dormitory-type building with arrangements for the group to be together during meals.

Selection of participants will be made from applications of science teachers at the two levels of instruction covered by the respective institutes. A letter of endorsement will be required from a responsible official of the participant's school.

Deadline for receipt of applications for the secondary-school institute is April 1, 1956. Applications for the college institute should be submitted before April 15, 1956.

Application blanks and additional information may be obtained by writing Chairman, Special Training Division, Oak Ridge Institute of Nuclear Studies, P.O. Box 117, Oak Ridge, Tennessee.

THE WORSHIP OF ISHTAR AMONG THE CUNA INDIANS OF SAN BLAS*

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While carrying out a genetic study upon the albinistic "Moon-children" so common among the primitive Cuna Indians of San Blas, Panama, I became extremely interested in certain cultural materials that had not been collected previously, and especially in detailed religious concepts that are difficult to obtain. These will be lost to a great extent during the next few decades as the pressure of Western Civilization from Panama eliminates the old Cuna culture.

The method of investigation consisted of inducing my old friend, Chief Ikwaniktipippi of Ailigandi, to draw complicated pictures of religious subjects and then to explain each of the persons and symbols represented in his pictures. During the past six years the chief has produced for me allegorical scenes depicting the Afterlife, the Sunboat, the Punishments of the Afterlife, the Earthmother's Children, Creation, the Birth of Tat Opa (Adam), and the Coming of Evil into the World. He told me about the Patriarchs before the Flood, and the Felling of the Paluwalla (Tree of Life). A few medicine men have helped with pictures and explanations, especially Manipekinappi, the Snake Bite Medicine Man of Mulatuppu.

This study revealed that the Cunas have at least eight of the Akkadian-Sumerian stories of Mesopotamia in a pre-Gilgamish form because they are told about different heroes rather than being collected together around one hero as they are in the famous Gilgamish

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FIGURE 1. *The Cuna Earthmother, Olokukurtilisop, giving birth to some of her children. Note the Trees of Life, Rivers of Life, Vulva, Table of Earthmother's Genitals, Creator God, Heaven in background.*

FIGURE 2. *Seal of Sargon of Akkadia showing Gilgamish with the Tree of Life and Water of Life symbol that he obtained in Heaven. Note the Cedars of Lebanon and the vase consisting of the Vulva and Uterus of a human female. The Bull of Heaven is stealing a drink from the Water of Life.*

Epic that has come down to us in cuniform writing on clay tablets. These stories are:

Creation of the Earthmother.
Birth of the Sun to the Earthmother.
Visit of a Hero to Various Layers of Heaven.
Fight of Two Heroes Against a Monster Guarding the Tree of Life.
Visit of a Hero to Various Layers of the Underworld.
Story of Several Destructions of the World Including the Flood.
Story of the Patriarchs Before the Flood.
Creation of the First Man.

FIGURE 3. *The horrible Monster of the Gilgamish Epic, Khumbaba, "with his intestines strewn over his face." This is really a human placenta showing an elongated umbilical cord rooted at the center of the nose and arranged upon the face.*

From these stories it is evident that the Cunas still worship the old Earthmother, Olokukurtilisop, and that her son, Olowaipippilele, although a Sungod, has never supplanted his mother. In fact, Chief Ikwaniktipippi told me that the only importance of the Sungod is that he returned to his mother's womb and investigated it thoroughly, thereby learning its "intricacies," that is, its magical influence on the development and maintenance of all life on earth including human beings. Her womb also receives and resurrects the dead to eternal life and gives them a golden body.

On the contrary, it is well known that in Mesopotamia the Earthmother religion of Ishtar evolved. Her child, the Sungod Bel-Marduk, came into the ascendancy as his mother declined just as Sunworship was embraced by Incas, Mayas, Aztecs and many other Indian tribes in the Americas. Thus, the Cuna religion has remained very primitive and complete, and the traditions of the fathers have been taught

FIGURE 4. *Cuna massart or Caretakers for the Soul, that protect and guide it on the journey to the underworld.*

form of chants for possibly more than one hundred and eighty generations.

When I visited the Cunas during five summers, it was as though I had rocketed back through time to 4000 B.C. and then talked to men about the then almost universal religion of the Great Earthmother.

If, as we have suggested, the Cuna Earthmother religion has remained unchanged, and the Mesopotamian religion has evolved, Chief Ikwaniktipippi of the Cunas may be able to interpret for us some of the unexplained religious symbols upon artifacts of old Mesopotamia prior to the ascendancy of the Sungod, Bel-Marduk. At least, his guess should be better than our inability to guess.

The Chief's picture of Creation (see Fig. 1) shows God the Father (Creator and Husband of the Earthmother) the Earthmother, the Earthmother's External Genitalia, the Earthmother's Vulva (God's Whirlpool), four branches of the Tree of Life and Two Rivers of Life. Four of the Earthmother's Children are present. This picture depicts the Great Earthmother at the time of childbirth. Upon questioning, the Chief admitted to me that the Trees of Life represent the umbilical cord and foetal membranes of the child. and the Rivers of Life or Water of Life are the salty amniotic fluid that flowed out to "form the oceans of the world."

Cuna medicine men say that during pregnancy, the spirits of the friendly whales bring back salt water from the ocean, which is really the Water of Life or Amniotic Fluid of the Great Earthmother, and infiltrate it into the amnion of the developing embryo.

If we go back to the symbol of the Tree of Life and Water of Life held up by Gilgamish on the Seal of Sargon I of Akkadia (see Fig. 2) and found on numerous other West Asian roll seals, we note the same portrayal of the childbirth scene, except that the Babylonian seals represent the excised human vagina and uterus, which together have the form of a vase without a base.

If we turn to the description of the Garden of Ishtar on Mount Lebanon or Mount Hermon given in the Gilgamish Epic, we see that this is the same mountain-lake-tree-river scene as drawn by Chief Ikwaniktipippi. The Trees of Life are the Giant Cedars of Lebanon. The four Rivers of Life are the Tigris, Euphrates, Jordan and Litani.

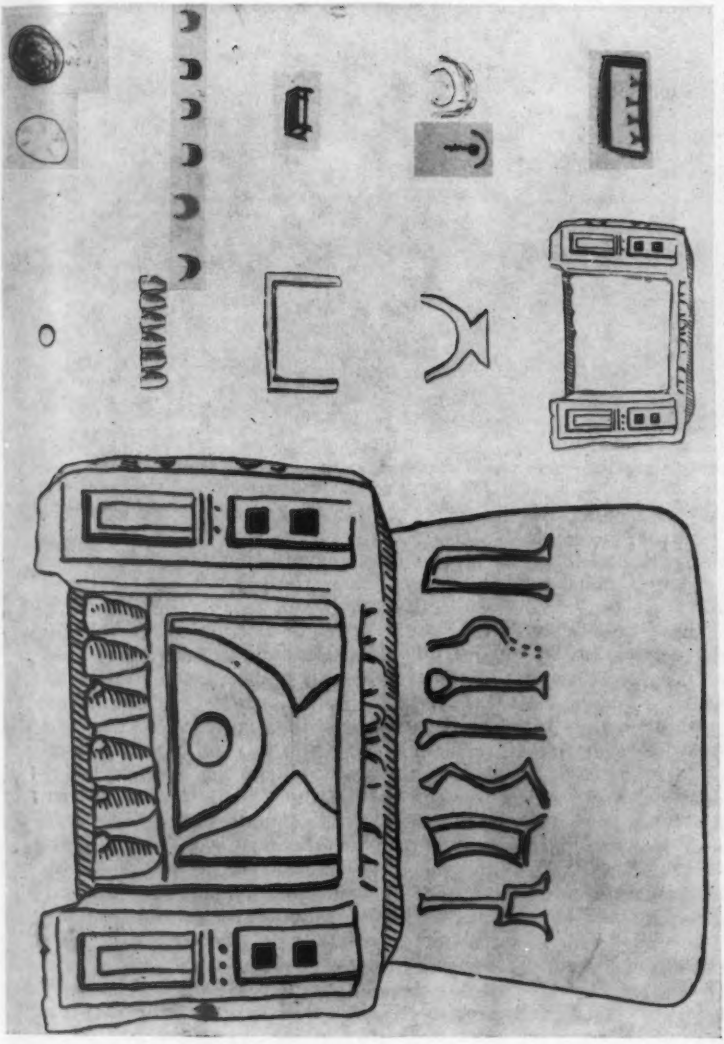

FIGURE 5. *Comparison of the symbols of the Sheba Altar with the Cuna medicine symbols describing the birth of children to Olokukurtilsop, the Cuna Earth-mother. The Cuna symbols are at the extreme right. Cuna symbols photographed from Cuna manuscripts.*

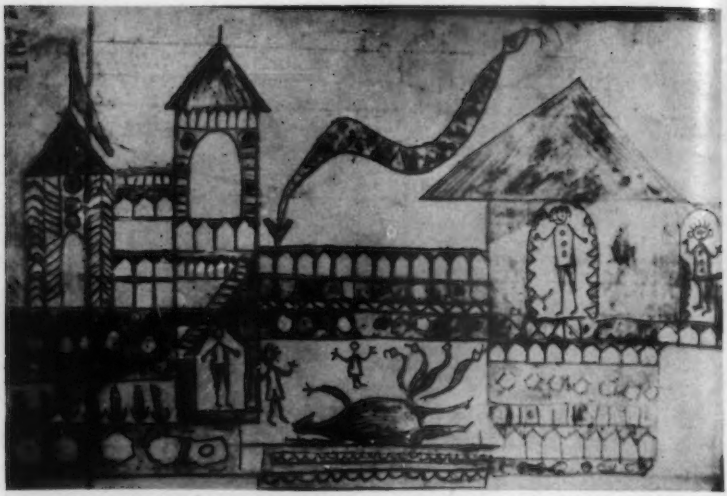

FIGURE 6. *The Cuna Earthmother, Olokukurtilisop, giving birth to the first snakes. This picture was made by Manipekinappi, the Snake Bite Medicine Man of Malatuppu. Note at the lower left seven cups of God's Semen, and that the Earthmother is giving birth in her Oloulu, or Sacred Golden Chamber.*

Then, following Ikwaniktipippi's symbolism, the Garden of Ishtar or Garden of Eden must be identified as the Genitals of the Great Earthmother at the time of Childbirth.

Gilgamish and Enkidu fought the horrible monster Khumbaba in the Garden of Ishtar. So horrible this monster was said to be that he had his intestines strewn all over his face (see Fig. 3). Old Chief Ikwaniktipippi tells me of Achusimmutupalit, a blood-curdling monster with a long umbilical cord associated with the Trees of Life, and probably the same jaguar-monster killed by Puksu the Morning Star. Puksu accompanied his brother Olowaipippilele the Sungod when the latter cut down the Tree of Life from which the salt water (amniotic fluid of the Earthmother) flowed out to form the oceans.

I sent to Ikwaniktipippi a picture of Gilgamish's "Tree of Life-Water of Life" symbol, and he said it was a picture of the birth of Achusimmutupalit, the jaguar-like monster. The Cunas still call the placenta their achu, or jaguar-like monster. Thus, Khumbaba may be identified as the human-type placenta with the umbilical cord elongated and arranged so as to outline a horrible face.

Chief Shup-She of the Potowattomies has a coup stick of modern times carved by Chief Swimming Eel of the Pskatituk tribe showing the Tree of Life and the Earthmother's Children including polliwogs, men, animals, birds and stars. It is called the "Tree of our Great Earthmother's Vulva." Two ancient columns from Peru show the same motif. A most elaborate, large, stone cylinder at Izapa in Southern Mexico depicts a similar arrangement of the Tree of Life, the

Water of Life, the two Heroes who fell the Tree of Life, the Earthmother's Children, the Holy Chamber of the Earthmother and even the Monsters that guard the Tree of Life.

Curiously enough, the Tree of Life of the Cunas is probably the Saptur tree, Genipa americana, related to coffee and cinnamon. It bears a fleshy fruit which yields a magic, black dye that wards off spirit devils. This dye was used by ancient hero shamans of the Cunas to resurrect dead children, because it is from the Fruit of the Tree of Life.

The Cunas say that in Heaven there is a grove of these sacred Saptur trees and that two monsters wander among them. The Monsters are Achusimmutupalit, the jaguar-like monster with the long umbilical cord, and Achunipali, a monster described as a sphinx that has a "Golden Chain." However, the "Golden Chain" has the name of "Olokwilotupa" which means "umbilical cord" and also the "spirit bridge" of the afterlife.

At the end of the Gilgamish Epic the Hero King Gilgamish goes to the Underworld and asks his deceased friend, Enkidu, what happens to the man who dies in the field and is never buried. The reply is that he cannot go to the Underworld without a "caretaker." Last summer I was on the Cuna island of Mulatuppu when a man died. The chanter who instructs the massart "caretaker" sticks on Mulatuppu, was visiting another island at the time, and the dead man was buried without ceremonial instructions to the "caretaker" sticks as to what to do. The fearful inhabitants of Mulatuppu said that the man's spirit was left wandering about the village and that it could never reach even the cemetery, let alone get to the Underworld, because the man's spirit had no "caretakers."

These "caretakers" (see Fig. 4) are reeds spiralled with sacred red makepa seed paint (representing Earthmother's blood that wards off evil spirits). The sticks are surmounted by a headdress of yellow feathers, and a string of beads. They have hair painted on them. At one time they were probably complete images because they had faces. They walk before, behind and on both sides of the soul brandishing flaming staves to frighten away angry devils until the spirit has arrived safely in the Underworld. The massart "caretakers" cannot function, however, without the Chant of Instruction or "Massar Ikar." Thus, we may suggest that Babylonian "caretakers" were probably images of similar function.

There is an ancient altar from Biblical Sheba in Southwest Arabia, the symbols upon which have defied interpretation, but identical symbols are still being used today in Cuna pictograph writing to record sacred chants about the Earthmother (see Fig. 5).

Some archeologists have guessed that a crescent-shaped figure with a base on this altar is the moon that has been given a base in order to make it stand up, but the old Chief says it is an "incense pot" which always represents the Earthmother's uterus among the Cunas.

If we take the Chief's suggestion, the symbols consist of a disc inside an incense pot with a table over it upon which stands six cups with handles, all inclosed in a large room of a house.

We may list the Cuna meanings of the symbols:

1) the disc is the Sun;
2) the incense pot is the Earthmother's uterus;
3) the table is the Earthmother's vaginal lips (labia majora) or possibly hymen;
4) the cups are cups of God the Father's semen;
5) the great room in the house is the Holy Chamber in which the Earthmother always brings forth her children.

The Cuna interpretation is something as follows: "To the Sungod who, after six matings with semen from God the Father (Creator), was conceived (deep ?)* in the womb of the Earthmother (Ever Virgin ?)* and born in the Earthmother's Holy Chamber."

Two Cuna pictures in my collection show the Earthmother's Holy Chamber. That made by Manipekinappi of Mulatuppu is the more elaborate (see Fig. 6). This picture also shows cups of God's Semen. The sacred medicine chants of the Cunas describe these cups as being arranged upon the Earthmother's Table of her External Genitalia; merely a poetic, and crystic method of saying that sexual intercourse took place.

Summary

By studying the intact Earthmother religion of primitive peoples today, we may find explanations for symbols on religious artifacts of the Mesopotamian Earthmother religion of possibly six thousand years ago.

Employing Cuna Indian Earthmother stories and symbols for comparison, this method (1) defines the Tree of Life and Water of Life symbol of the Gilgamish Epic as the female genital organs at childbirth. (2) It identifies the Garden of Ishtar (Garden of Eden of the Bible) as the sex-organs of the Great Earthmother in Childbirth with the Giant Cedar Trees of Life as the umbilical cord and foetal membranes, and the Water (or Rivers) of Life as the amniotic fluid. (3) It explains the "caretakers" of the Gilgamish Epic as probably images placed in the grave. (4) It shows the monster Khumbaba to be the placenta and cord of the Great Earthmother. (5) It gives a logical interpretation to symbols on the Sheba altar.

Bibliography

Fraser, J. G., 1922, The Golden Bough. New York, MacMillan Co.

Gray, L. H., 1916, The Mythology of All Races. Boston, Marshall Jones Co.

Hastings, James, Ed., 1922, Encyclopaedia of Religion and Ethics. New York, Chas. Scribner's Sons.

Leonard, W. E., 1934, Gilgamish. New York, Viking Press.

Ward, W. H., 1910, Seal Cylinders of Western Asia. Washington, Carnegie Institution.

*The table symbol may merely stress the fact that it is really the Earthmother's uterus for which I have added "deep" in parentheses. It may possibly refer to the intact hymen, in which case it might be translated "ever virgin," and Ishtar the Earthmother, in spite of many sex affairs, was said to be the "Ever Virgin Mother."

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